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Hawaii Plant Materials Center

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Location

The Hawaii Plant Materials Center (PMC) is located on the island of Molokai and situated on the fertile agricultural plains of Ho'olehua. It is one of 26 Centers located throughout the United States. The island of Molokai is 27 miles long and 11 miles wide (261 square miles) and the fifth largest island in the Hawaiian chain. The Center is responsible for servicing the plant conservation resource needs of Hawaii and the Pacific Basin, which includes Guam, Northern Mariana Islands, Federated States of Micronesia, Republic of Belau, Republic of the Marshall Islands and American Samoa.

The Hawaii Plant Materials Program

Controlling erosion and enhancing and protecting our resource base through the use of vegetative plant materials is our main concern. The Plant Materials Program develops, tests and transfers effective state of the art plant science technology to meet customer and resource needs.

Current Priorities and Status

The Hawaii PMC is currently involved in addressing the following concerns:

- **Native plant re-vegetation efforts on the island of Kaho'olawe**
- **Developing native plants to address resource concerns**
- **Multi-use windbreaks; natives and non-natives**
- **Screening cover and green manure crops for diversified agricultural operations**
- **Screening plants for contour hedgerow applications**

FY 2000 Accomplishments:

Kaho'olawe Island Native Plant Revegetation Efforts

The tiny island of Kaho'olawe (45 sq. miles) located seven miles off the south coast of east Maui has been rapidly eroding for nearly two hundred years. Overgrazing, mismanagement, and military bombing has left the

upper one third of the island severely eroded, barren of vegetation and virtually uninhabitable. The island receives an annual rainfall between 10 to 27 inches per year and is very hot and windy. In 1993 the island of Kaho'olawe was returned to the State of Hawaii with the stipulation that the Department of Navy implement restoration to the island and control the soil erosion problems. In the same year the State of Hawaii created the Kaho'olawe Reserve and the Kaho'olawe Island Reserve Commission (KIRC). This enabled the State to receive federal funds for their restoration efforts. In 1997, the Hawaii PMC received requests from the KIRC for assistance in providing native plants, seeds and technical support for restoration efforts. In 1999 the Hawaii NRCS received a congressional earmark directing our efforts as part of their revegetation effort. This earmark also enabled NRCS to participate in developing training programs on the propagation of native plants, which may enable some economic stimulation for local community entrepreneurs.



Kaho'olawe Island showing heavily eroded and barren landscape.

Current Status:

As part of the revegetation effort for Kaho'olawe four native plants were selected as the initial plants to be delivered to the KIRC. These include; Heteropogon contortus, piligrass; Eragrostis variabilis, kawelu; Chenopodium oahuense 'aweoweo; and Dodonaea viscosa, 'a'ali'i. These four selections performed well during initial evaluations at the PMC and are well suited for the dry, windy and sometimes infertile conditions that endure on Kaho'olawe. A brief description and their current production status follows:

Piligrass

Piligrass is a perennial native bunch grass and is commonly found on all major islands. It mainly grows in arid and sometimes rocky areas from sea level to over a thousand feet. Piligrass was the main thatching material used by Polynesians for construction of their homes.

The pili being propagated at the Center was first collected on

the island of Kaho'olawe in the early 1990's and expressed good plant vigor and seed production characteristics. Its ability to tolerate the arid conditions, good seed production and germination made it an ideal candidate for controlling the erosion of

Kaho'olawe.



Nancy Bauman, biological science technician, ready to ship cleaned pili seed to KIRC.

transplant. At the end of 1999 the PMC delivered approximately 200 pounds of cleaned piligrass seeds to the KIRC. The seed harvesting and cleaning process of pili was the most challenging.

In 1999 the first large-scale production of piligrass increase fields were established at the PMC with 1.2 acres planted by seedling

Conventional combining could not ready condition the seeds to an acceptable state due to the sharp pointed seed callus, long awns and tangling characteristic of the seed. A flail-vac harvester was used instead to collect seeds. The seeds were then sent through a thresher to detach seed from the long awns and finally through a seed clipper for final cleaning.

In addition to seeds, the Hawaii PMC is also sending native straw bales of piligrass to the island for revegetation and stabilization. The technique for baling native

grass seeds for revegetation was studied and tested at the Tucson Plant Material Center in

Arizona. It involves the conventional baling procedure for mature grass species with mature seeds. The native straw bales are transported to the desired site and spread to cover the eroded site. In time seeds germinate from the spread bales. This approach to revegetation has several benefits. The straw acting as a mulch will conserve



David Duvauchelle, biological science aide, shrink wraps pili bales prior to shipment.

moisture, trap sediment, reduce the impact from rain thereby enhancing deeper water penetration instead of surface runoff, and reducing soil loss, and providing a micro environment for the native grass to have a good chance of germination and survival. The



Baled piligrass.



Piligrass stowed until shipment.



Increase field of piligrass.



Piligrass bales being hooked-up to helicopter for delivery to Kaho'olawe.

bales could also be placed whole and used as physical barriers, laid on contour to trap sediment or provide a barrier from the wind so young natives can take hold. Currently 186 bales or 4.6 tons of straw bales have been airlifted by helicopter to Kaho'olawe.

A'ali'i

'A'ali'i is a native perennial shrub or small tree that is commonly found on all major islands, except Kaho'olawe. It grows in a variety of environmental conditions. It is easily propagated from seed and once established can produce an abundance of seeds. The wood of 'a'ali'i is dense and was used by early Polynesians for tools and spears. Seeds were also used in making dye. The colorful pink to maroon seed capsules are used for lei making and hula dance rituals.

A'ali'i is used as a field windbreak or wildlife habitat. The 'a'ali'i currently being grown for Kaho'olawe was collected in the wild on the island of Molokai in the late 1990's. Seeds were collected from the Kamiloloa district between the elevation of 1000 to 2000 feet and from several hundred randomly selected plants.



'A'ali'i increase field planted in March 2000.

In December of 1998 the first increase rows of 'a'ali'i were planted. A total of two thousand linear feet was planted by mid 1999. By early 2000 an additional five acres of land was cleared, prepped and planted with an additional four thousand linear feet of 'a'ali'i. In the summer of 2000, seeds of the 1998 'a'ali'i initial increase row were harvested and cleaned. A modest yield of approximately four pounds of seeds was harvested. An area of approximately 1.5 acres of land will be dedicated to the increase of 'a'ali'i. Current yields are below anticipated projections but is anticipated to increase as plants mature.

Kawelu

Kawelu or emoloa is an attractive native perennial bunch grass that is found in open Hawaiian dry land forest or coastal dunes throughout Hawaii. It produces an abundance of seeds year round and is very easy to propagate. Kawelu was sometimes used by early Polynesians as an alternative to piligrass for house thatching.



Initial field increase block of Kawelu. Seeds from this block will be further increased in 2001.

Seeds of Kawelu were first collected on the island of Kaho'olawe. It was found growing as a volunteer plant some distance away from the original test site under very dry, windswept eroded conditions. Seeds were collected from various individual plants and planted at the Hawaii PMC for initial evaluation in 1996. Kawelu grew well at the PMC producing an abundance of seeds and foliage. The tall upright growth characteristic of the plant made it conducive to cultivate it under large-scale production, harvesting and cleaning by mechanical means.

In the summer of 2000, two thousand linear feet of Kawelu was planted by transplanted seedlings. Seeds from this initial increase block will be harvested and planted for FY-2001 large-scale production field. Approximately one acre of Kawelu is planned for planting by mid-summer 2001.

'Aweoweo

'Aweoweo is a woody native perennial dryland shrub or small tree. It is found on all major islands except Kaho'olawe.

'Aweoweo is an extremely drought tolerant plant and readily reproduces itself by seed. Initial evaluations of 'aweoweo showed it

to be a fast growing plant with very little insect or disease problems. 'Aweoweo can be seen growing vigorously along road cuts and infertile eroded sites. This attribute made it an ideal candidate for Kaho'olawe.

In the summer of 1999 seeds of 'aweoweo were collected from the wild in the Kamiloloa district of Molokai. Seeds were randomly collected from several hundred individual plants between the elevation of 1000 – 2000 feet. By December of 1999, 2000 linear feet of 'aweoweo seedlings were planted as initial seed increase blocks. The 'Aweoweo grew very well expressing good vigor and seed production.

In August of 2000 harvesting of 'aweoweo began. Various attempts were made to find the best way to mechanically harvest the seed. 'Aweoweo seeds are extremely small and initial attempts with the combine and flail-vac harvester proved to be a challenge as the tiny seeds of 'aweoweo could not be collected effectively in the hopper. The combine and flail-vac blowers were discarding much of the seeds. After much trial and error it was determined that the combine would do the best job in harvesting the seed. In order to trap the seeds from blowing out of the combine the staff at the PMC constructed a catchment system behind the combine to trap whatever seeds could not be collected in the hopper.

After the initial harvesting and cleaning a total of 30 pounds of aweoweo seeds had been collected from 1200 feet of 'aweoweo. The seeds collected will be used in FY-2001 for a large-scale increase of the 'aweoweo.



Initial field increase row of 'Aweoweo ready for harvest.

Developing Native Plants To Address Resource Concerns

Kamiloloa Germplasm 'A'ali'i Released in 2000

The Hawaii PMC recently released the Kamiloloa Germplasm 'A'ali'i. This is the first native Hawaiian plant to be released by the Hawaii PMC for conservation use. *Dodonaea viscosa* or more commonly called 'A'ali'i is a source identified release, "Kamiloloa" identifying the original collection location on the island of Molokai.

Kamiloloa Germplasm 'A'ali'i was released to address specific ecotypes from the Maui Nui Group which includes Maui, Lanai, Molokai and Kaho'olawe. The need for native plants for conservation efforts has been emphasized for the past few years and especially for the re-vegetation efforts for the island of Kaho'olawe.

'A'ali'i can grow to a shrub or small tree. It normally grows from three to 11 feet high and two to 18 feet wide. The long, slender leaves are usually dark green, waxy or crinkled. The flowers are very small with female flowers developing into attractive paper



Latest PMC native plant release, *Kamiloloa Germplasm 'A'ali'i*.

lantern-like capsules that are dark maroon, red, pink, and green in color. It is extremely drought and wind resistant and can grow from sea level to over 7,000 feet. It can be found growing in open lava fields to semi-arid to wet forests throughout the tropics.

Kamiloloa Germplasm 'A'ali'i has the potential for ecosystem restoration, stabilizing highly eroded sites, improving wildlife habitat, landscape and windbreaks. The colorful flowering capsules are widely used for making haku leis.

Living Mulch for Native Dryland Plant Re-vegetation in Hawaii

In partnership with the University of Hawaii and the NRCS, a trial was initiated to use a non-native grass species as a nurse crop for the establishment of native dryland shrubs. The study was in conjunction with the ongoing Kaho'olawe re-vegetation efforts.

The study, under the leadership of Dr. Joseph DeFrank, University of Hawaii Weed Science Specialist, involved naturalized stands of buffelgrass (*Cenchrus ciliaris*) at the PMC, (a non-native bunch grass) as a living mulch to establish native dryland shrubs. Buffelgrass was the selected grass because a significant portion of Kaho'olawe is already established in the bunch grass and the technology generated at the PMC could possibly be used on Kaho'olawe. The native species include *Dodonaea viscosa*, 'a'ali'i; *Chenopodium oahuense*, 'aweoweo; *Bidens menzeisii*, ko'oko'olau; and *Sesbania tomentosa*, ohai.

Objectives of the study:

1. To demonstrate the management of a living mulch of buffel grass to serve as a nurse crop for the establishment of four native Hawaiian dryland shrubs.
2. To identify which of the four species of native plants is best suited to establishment and growth in chemically managed living grass mulch.
3. To determine the response of four native species to fertilization.
4. To determine the sensitivity of four native species to two herbicides commonly used for weed management in conservation and forestry (Roundup and Garlon 4EC).

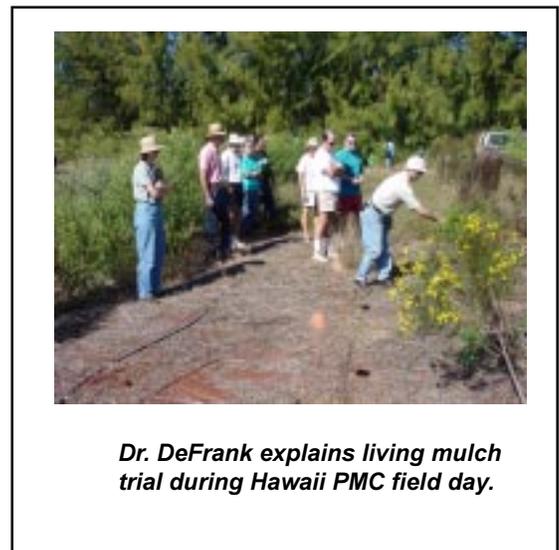
Benefits of a living mulch:

- reduce soil erosion
- minimum tillage
- weed suppression
- moisture retention
- deep moisture penetration
- wind protection for native seedlings
- use of selected herbicides that will not adversely affect native shrubs
- reduction of insect injury to plants
- decrease mortality rates of native plants

Results

The ranking for native plants best adapted to establishment and growth in a living mulch is ohai > 'a'ali'i > ko'oko'olau > 'aweoweo. The ranking for improved growth of native plants due to fertilization is ohai > 'a'ali'i > ko'oko'olau > 'aweoweo. The ranking for most sensitive to herbicides applied to maintain a weed free bare ground plot is ko'oko'olau > 'a'ali'i > 'aweoweo > ohai.

Buffel grass is non-native and viewed by many ecologists as invasive, but it still can play an important role in the establishment of native trees and shrubs in drought stressed areas.



Other Work with Natives

Numerous work with other natives is currently being conducted at the PMC. These include a variety of native dryland trees and shrubs to encourage wildlife habitat, windbreaks, and erosion control. Plant species include the following:

Scientific Name	Common Name
1. ¹ <u>Thespesia populnea</u>	Milo
2. <u>Erythrina sandwicensis</u>	Wiliwili
3. ¹ <u>Cordia subcordata</u>	Kou
4. <u>Acacia koa</u>	Koa
5. <u>Nototrichium sandwicense</u>	Kuluji
6. <u>Meterosideros polymorpha</u>	Ohia
7. <u>Hibiscus rockii</u>	
8. <u>Myoporum sandwicense</u>	Naio
9. <u>Sophora chrysophylla</u>	Mamane
10. <u>Alphitonia ponderosa</u>	Kaula
11. <u>Dodonaea viscosa</u>	'A'ali'i
12. <u>Sesbania tomentosa</u>	Ohai
13. <u>Gossypium tomentosum</u>	Ma'o
14. <u>Sporobolus virginicus</u>	'Aki' aki
15. <u>Dubautia linearis</u>	Na'ena'e
16. <u>Canthium odoratum</u>	Alahe'e
17. <u>Cocculus trilobus</u>	Huehue
18. <u>Scaevola sp.</u>	Naupaka

¹ Early Polynesian introduction.



Native and Polynesian introduced dryland forest trees at Hawaii PMC.

Screening Cover and Green Manure Crops for Diversified Agriculture Operations

'Tropic Sun' Gains Popularity

Crotalaria juncea 'Tropic Sun' or more commonly called sunn hemp has been gaining considerable recognition in the last several years. A fast growing annual legume that can produce over 2 tons of biomass and over 100 pounds of nitrogen per acre in 2 months. It is also resistant to root-knot nematodes and is not toxic to livestock. 'Tropic Sun' is a 1983 Hawaii NRCS and University of Hawaii College of Tropical Agriculture and Human Resources cultivar release.

The principal use of 'Tropic Sun' is for soil improvement as a green manure crop. It is an excellent, rapid growing green manure to be included in rotation with vegetable, flower and other crops to add nitrogen and organic matter, to suppress weeds and to reduce root-knot nematodes.

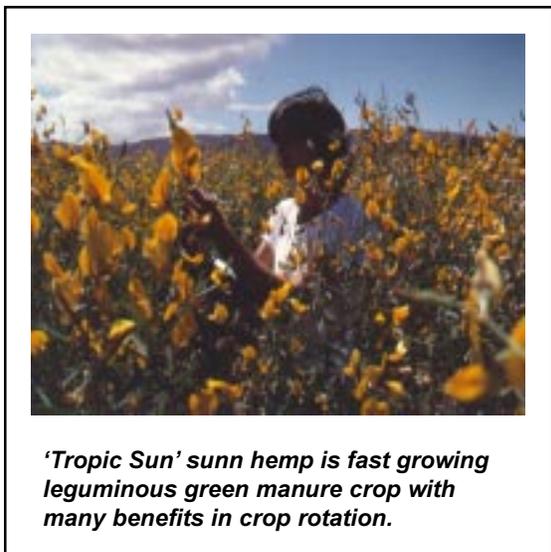
In recent years researchers in Hawaii and the Southern United States have been studying 'Tropic Sun' for its many positive attributes. On the mainland sunn hemp has promise as an alternative to winter legume cover crop to increase organic matter and produce nitrogen. A period of 8 to 12 weeks of warm weather (frost-free) is needed to provide the benefits that 'Tropic Sun' provides. 'Tropic Sun' has been tested in rotation with Kenaf (Hibiscus cannabinus) for non-wood fiber production with good results. Kenaf is susceptible to root-knot nematodes while 'Tropic Sun' is not. Sunn hemp could be used after early season vegetable, tobacco, and small grains or other winter crops (Canola) in the summer or after corn in southern climates and prior to winter grains. With the imminent restrictions on the use of nematicides and pesticides for crops 'Tropic Sun' may soon be the only alternative for farmers to comply with government requirements.

One of the limitations of 'Tropic Sun' is the availability of a dependable seed source. Current demands for the seeds have exhausted local Hawaiian suppliers and producers. In Florida trials are underway to determine if 'Tropic Sun' could be a viable commercial seed producing crop.

Because of the growing interest in the commercial production of 'Tropic Sun' seeds, the Hawaii PMC planted and compared seed yields from increase fields of sunn hemp. The intent of the demonstration was to compare seed yields from two different cultural

planting methods (broadcasting and drilling) of sunn hemp. Except for the planting method and the cultivating of the drilled treatment, irrigation, fertilization, pre-emergence herbicide application, harvesting and cleaning was done the same for both methods of planting.

One field was drilled at a rate of 13 pounds per acre in rows spaced 34 inches apart and the other was broadcasted at a rate of 60 pounds pure live seed (pls) per acre. Both sections were fertilized with 0-45-0 fertilizer at a rate of 150 pounds phosphorus



'Tropic Sun' sunn hemp is fast growing leguminous green manure crop with many benefits in crop rotation.

per acre rate. Pre-emergence herbicide was applied to both fields and irrigated equally for the duration on the planting. The drilled section of sunn hemp was cultivated once during the first four weeks of growth.

In June of that year seeds were harvested with the following yields:

Broadcast field – 1075 pounds per acre.

Drilled field – 1360 pounds per acre.

Discussion

The drilled field yielded 285 pounds more seed per acre than the broadcast section. Weeds were much more prevalent in the broadcast field even though a higher rate of seeds was planted to suppress weeds and a pre-emergent herbicide was applied. Drilling seeds clearly indicate increase seed yields and the reduced use of seed stock for planting. It can be summarized that for every pound of seed broadcasted a return of 18 pounds can be expected. In comparison, for every pound drilled you can expect a return of 105 pounds of seed.

Screening Plant for Contour Hedgerow Application

Many of the farmlands in Hawaii and the Pacific Basin are situated on steep hillsides. Alternative conservation practices to help local farmers control their erosion problem is ongoing. Contour hedgerow enables farmers to plant leguminous plants or grasses strategically on the contour, thereby providing vegetative barriers to trap and filter sediments. This practice allows farmers to install conservation practices where machinery cannot. The following are brief descriptions on promising hedgerow plants currently under evaluation.

Vetiver Grass

Vetiveria zizanioides, or more commonly called vetiver grass, is a tough, stout, upright perennial bunch grass. It has gained worldwide recognition as a superb grass in controlling soil erosion. Originally from India it has been used for generations for agriculture use.

For years the roots of vetiver have been commercially harvested to extract its oils that are used in perfumes, lotions, soaps, and cosmetics. It is fast growing reaching heights in excess of 5 feet in just one year. It produces an abundance of leaves that are somewhat like sugarcane, only narrower. Its stems are stiff, strong and lignified and provide the rigidity of an erosion control barrier.



'Louisiana Sunshine' vetivergrass increase row at PMC.

'Louisiana Sunshine' vetiver grass is a sterile variety of this grass that is currently being evaluated at the Center. It can only be propagated vegetatively by slips. Seeds of this selection were collected and sent to the Hawaii Department of Agriculture to verify that they were non-viable. 'Louisiana Sunshine' has expressed good vigor and plant growth at the Center. It is currently planted at the PMC for field planting trials.

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